

METAL POLISH COMPOSITION AND POLISHING METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a metal polish composition.

Description of the Related Art

Recently, there are various fine processing technologies studied and developed for high integration and high performance of LSI. Among them, a chemical mechanical polishing (hereinafter, abbreviated as CMP) method combining a chemical action between a polish and a body to be polished and a mechanical action of a polishing particle in a polish is a technology important for planarizing of an insulating interlayer, formation of a metal plug, formation of an embedded metal wiring, separation of an embedded element and the like, and therefore investigated variously.

For example, JP-A No. 10-310766 discloses a polish composition composed of a polish such as silicon dioxide and the like, an ammonium compound and water, and also discloses that a chelate compound may also be added. However, since this chelate compound is added for the purpose of holding and stabilizing the quality of a product, when polishing was conducted using said polish composition, satisfactory

polishing speed could not be obtained.

JP-A No. 4-363385 discloses a polish composition composed of a chelate compound, alumina, aluminum salt and water, and JP-A No. 11-21545 discloses a polish composition composed of a chelate compound, a polish such as silicon dioxide and the like, a metal salt and water. However, also when polishing was conducted using said polish compositions, satisfactory polishing speed could not be obtained.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a metal polish composition which can polish metals at high speed.

The present inventors have intensively studied for a metal polish composition having no problems as described above and resultantly found that when a metal polish composition containing a chelate resin particle and an inorganic particle is used for polishing of a metal film of a semiconductor device, the metal can be polished at high speed, and have completed the present invention.

Namely, the present invention relates to a metal polish composition comprising a chelate resin particle and an inorganic particle.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention will be described in detail below.

The metal polish composition of the present invention is characterized in that it comprises a chelate resin particle and an inorganic particle.

A chelate resin particle carries on the surface thereof a polydentate ligand having a plurality of coordinated atoms forming a complex with a metal. In general, when a polydentate ligand having two or more coordinated atoms is bonded to a metal ion, a chelate ring is formed, and stability increases higher than that of a complex coordinating a monodentate ligand, consequently, an ability of arresting a metal ion to be polished increases and a chemical action can be increased.

As the functional group carried on a chelate resin particle, functional groups containing at least one atom selected from the group consisting of an oxygen atom, nitrogen atom, sulfur atom and phosphorus atom are listed.

As the functional group, for example, an aminocarboxylate group, aminophosphonate group, iminodiacetate group and the like are mentioned and an iminodiacetate group is preferable from the standpoint of an ability of arresting a metal ion.

As the chelate resin particle having these functional groups,

that of Na type in which a counter ion of a functional group is a sodium ion is generally used, and when applied to a semiconductor production process, a sodium ion exerts a reverse influence on device properties by diffusion into an insulating film, and the like, therefore, there is preferably used as a counter ion, in the present invention, a hydrogen ion (H type) or an ammonium ion (ammonium type) represented by the following general formula having little influence on a semiconductor device.



In the formula, R₁, R₂, R₃ and R₄ each independently represent a hydrogen atom, an alkyl group having 1 to 5 carbon atoms or a benzyl group.

R₁, R₂, R₃ and R₄ represent preferably a hydrogen atom or an alkyl group having 1 to 5 carbon atoms, more preferably a hydrogen atom. Examples of saturated alkyl group having 1 to 5 carbon atoms include a methyl group, ethyl group, propyl group, isopropyl group, butyl group, isobutyl group, sec-butyl group, tert-butyl group, pentyl group, isopentyl group, neopentyl group, tert-pentyl group and the like.

Chelate resin particles having an aminocarboxylate group, aminophosphonate group and iminodiacetate group as a functional group can be produced by known methods. For example, there are mentioned a method in which a monomer having the intended

functional group is polymerized, a method in which a functional group carried on a polymer particle polymerized is chemically converted into the intended functional group, and other methods.

Also when at least one selected from the group consisting of the H type and the ammonium types of the above-mentioned general formula is used as a counter ion of a functional group, known methods can be applied. For example, there are mentioned a method in which the intended counter ion is formed from the stage of raw materials, a method in which other counter ion is converted into the intended counter ion by an ion exchange method, and other methods. In the case of the ion exchange method, it is possible that, for example, chelate resin particles produced in which a counter ion is in the form of Na type are filled in a column and a hydrochloric acid aqueous solution is passed through this column to convert it into a H type, and an amine aqueous solution is further passed through this to convert it into an ammonium type. In the ion exchange method, it is also possible to conduct batch-wise treatment by stirring and the like in addition to the method of passing through a column.

Though it is preferable that a functional group of a chelate resin particle is present on the surface of the resin particle, even if not present on the surface of a particle, if functional

groups arresting a metal can be exposed on the surface and allowed to contact with a metal to be polished by breaking of particles or peeling of a coating film due to stress in polishing, and the like, those functional groups are preferably used because the same effect is obtained.

Chelate resin particles preferably have an average particle size of 1.0 μm or less. When the average particle size of the particles is 1.0 μm or less, process precision of the polishing surface is further improved, desirably. Here, the term average particle size means an average particle size measured by a dynamic light scattering method (average secondary particle size) in the present invention.

Though chelate resin particles having an average particle size of 1.0 μm or less can be produced directly by polymerization, these particles can be obtained also by wet-grinding polymer particles having an average particle size of over 1.0 μm .

In this wet grinding, known grinding apparatuses such as, for example, a vibration mill, ball mill and the like can be used. It is preferable to use zirconia or polymer in a liquid contact portion to prevent metal contamination from a grinding apparatus, and the like. Further, if necessary, it may also be permissible to classify and control coarse particles into desired particle sizes, by operations such as wet gravitational

precipitation, centrifugal precipitation, filtering and the like.

Conducting coarse grinding treatment by dry grinding before effecting wet grinding is suitable since grinding efficiency in wet grinding can be enhanced. For the dry grinding method, known grinding apparatuses such as, for example, a jaw crushed, gyratory crusher, roll crusher, edge runner, hammer crusher, ball mill, jet mill, disk crusher and the like can be used. For prevention of metal contamination from a grinding apparatus, and the like, it is preferable to use zirconia or polymer in a contact portion. If necessary, it may also be permissible to classify and control coarse particles into desired particle sizes, by apparatuses such as a dry mode wind force classification apparatus and the like.

Though it is preferable that at least one selected from the group consisting of the H type and the ammonium types of the above-mentioned general formula is used as a counter ion of a functional group in a chelate resin to be wet-ground, it may also permissible, when the counter ion is not of the H type or ammonium type, to convert the counter ion into the H type or ammonium type by ion exchange. For example, a H type can be obtained by wet-grinding a chelate resin of Na type, then, adding a protonic acid such as hydrochloric acid, nitric acid

and the like to free a sodium ion, and removing a sodium ion by filtration through a film, and the like. Further, an ammonium type can be obtained by adding an amine to thus obtained H type.

The concentration of chelate resin particles in the polish composition of the present invention is preferably from 0.1 to 20% by weight. When the concentration of chelate resin particles is less than 0.1% by weight, there is a tendency that sufficient polishing speed cannot be obtained, on the other hand, when the concentration of chelate resin particles is over 20% by weight, there is a tendency that improvement in polishing speed corresponding to the addition concentration is not recognized.

The zeta potential of a chelate resin particle and the zeta potential of an inorganic particle in the polish composition of the present invention are preferably in the same sign, and it is more preferable that both of them have negative zeta sign. When the zeta potential of a chelate resin particle and the zeta potential of an inorganic particle are in reverse sign each other, there is a tendency that sufficient polishing speed cannot be attained. The zeta potential was measured by a zeta potential measuring apparatus of laser doppler mode (trade name: Coulter DELSA 440SX, manufactured by Coulter).

As the inorganic particle used in the present invention, for example, inorganic particles made of metal oxides such as silica, alumino silicate, cerium oxide, manganese dioxide, zirconia and the like are mentioned. Of these inorganic particles, a silica particle is preferable since the hardness thereof is lower than that of other inorganic particles and consequently scratch is not easily occurs on a metal film, and the particle does not easily precipitate due to its specific gravity near that of water, and colloidal silica is more preferable since it is cheap and does not cause scratch easily since the form of this particle is near sphere. These inorganic particles may be used alone or in combination of two or more.

If the average particle size of chelate resin particles is represented by A and the average particle size of inorganic particles is represented by B, the ratio of average particle sizes (A/B) is preferably 30 or more. When the ratio of average particle sizes (A/B) is less than 30, the effect of the present invention tends to become smaller.

The concentration of inorganic particles in the polish composition of the present invention is not particularly restricted, and preferably 0.1% by weight or more and less than 6% by weight for improving the ratio of the polishing speed of a metal film to the polishing speed of an insulating film,

and preferably 6% by weight or more for further improving the polishing speed of a metal film. When the concentration of inorganic particles is less than 0.1% by weight, there is a tendency that sufficient polishing speed cannot be obtained.

The polish composition of the present invention may further contain a polishing accelerator, and as this polishing accelerator, for example, nitric acid and salts thereof are listed. Specifically, nitric acid and, an ammonium salt, sodium salt, potassium salt, lithium salt, beryllium salt, magnesium salt and calcium salts of nitric acid are listed. However, when a substrate applied is a silicon substrate for semiconductor integrated circuit or the like, nitric acid or ammonium nitrate is preferably used to prevent contamination by an alkaline metals, alkaline earth metals and the like.

The concentration of the polishing accelerator in the polish composition of the present invention is preferably from 0.1 to 20% by weight. When the concentration of the polishing accelerator is less than 0.1% by weight, there is a tendency that sufficient polishing speed cannot be obtained, on the other hand, when the concentration of the polishing accelerator is over 20% by weight, there is a tendency that improvement in polishing speed corresponding to the addition concentration is not recognized.

The polish composition of the present invention is usually dispersed in water and used in the form of slurry, and pH thereof is preferably from 3 to 9, more preferably from 4 to 8.

To the polish composition, a pH regulator may be added, and as the pH regulator, known acids and alkalis can be used, and it is preferable to use acids and alkalis such as nitric acid, phosphoric acid, sulfuric acid, ammonium hydroxide, amine and the like containing no metal ion.

To the polish composition of the present invention, a surfactant can also be added for the purpose of preventing precipitation of abrasive grains, keeping the quality of a product, providing stability for a long period of time, preventing scratch and dishing, and the like.

As the surfactant, anionic, cationic, nonionic and ampholytic surfactants can be used, and two or more of them can also be used in combination.

To the polish composition of the present invention, a corrosion inhibitor and the like can also be added so as not to generate scratch and dishing and the like depending on the kind of a film to be polished. As the corrosion inhibitor, known corrosion inhibitors can be used, and it is preferable

to use benzotriazole and benzotriazole derivatives. The concentration of the corrosion inhibitor is preferably in the range from about 0.01 to 1.0% by weight based on the composition.

The speed of polishing a metal film can be improved by further compounding an oxidizing agent into the polish composition of the present invention.

As the oxidizing agent, for example, known oxidizing agents such as hydrogen peroxide, hydroiodic acid, hydroiodate and the like are listed, and of them, hydrogen peroxide is preferable.

The content of the oxidizing agent is usually from about 0.1 to 15% by weight based on the composition. When the content of the oxidizing agent is less than 0.1% by weight, there is a tendency that an effect of improving polishing speed is not easily manifested, on the other hand, when over 15% by weight, there is a tendency that improvement in polishing speed corresponding to the addition concentration is not recognized.

In preparation of the polish composition of the present invention, mixing order and the like are not particularly restricted. When dispersed in water to give slurry, known methods, for example, dispersion methods using a homogenizer, ultrasonic wave, wet medium mill and the like can be applied.

When an oxidizer is compound, all components may be mixed previously, alternatively, an oxidizer and other components are separately prepared and both of them are mixed in use to give a composition of the present invention,

Further, it may also be permissible that a liquid concentrate of relative high concentration of the polish composition of the present invention is prepared and diluted in use and used in actual polish processing.

The polish composition of the present invention thus obtained is suitably used for polishing a metal film in production of a semiconductor device.

As the metal film to be polished, a pure aluminum (Al) film, a film made of an alloy mainly consisting of aluminum such as an aluminum-silica-copper (AlSiCu) alloy, aluminum-copper (AlCu) alloy and the like, a pure copper (Cu) film, tungsten film, titanium film, titanium nitride film, tantalum film, tantalum nitride film and the like are listed, and preferable are metal films containing tantalum, and more preferable are a tantalum film and tantalum nitride film.

The polishing method of the present invention is a method of polishing a metal by chemical mechanical polishing, and characterized in that the metal polish composition of the present invention is used as a polish composition.

According to the polishing method of the present invention, a metal film can be polished at high speed.

EXAMPLES

The present invention will be described below by examples, but it is needless to say that the scope of the invention is not limited by the examples.

As the average particle size of particles in the slurry, the accumulated 50% diameter was measured by a micro track UPA particle size analyzer (manufactured by Nikkiso K.K.).

The polishing speed was measured by polishing, under the following conditions, a wafer carrying a tantalum film (Ta film) formed by sputtering or a wafer carrying an insulating film (SiO_2 film).

[Polishing conditions]

Polishing machine: MECAPOL E-460 (PRESI)

Pad: polyurethane type

Revolution of revolving surface plate: 60 rpm

Revolution of wafer supporting table: 60 rpm

Polishing pressure: 200 g/cm²

Flow rate of polish: 100 ml/min

Polishing time: 1 minute

Example 1

(Preparation of chelate resin slurry)

3 kg of a chelate resin having an iminodiacetate group as a functional group (trade name: Sumichelate MC-700, manufactured by Sumitomo Chemical Co., Ltd., counter ion : Na type) was dry-ground by a hammer mill (revolution: 14000 rpm, screen diameter: ϕ 1.0 mm). The average particle size was 126 μ m. The resulted ground product was dry-ground again by a hammer mill (revolution: 14000 rpm, screen diameter: ϕ 0.3 mm). The average particle size was 91 μ m. 310 g of pure water was added to 300 g of the resulted ground product, and the mixture was subjected to ball mill treatment under conditions of a revolution of 70 rpm and a treating time of 30 hours using zirconia balls of 5 mm ϕ . The average particle size of resin particles in the resulted slurry was 0.344 μ m.

Thus obtained resin particle slurry was dispersed in a buffer of 0.01 N potassium chloride water, and pH of this water dispersion was controlled to about 2 to 11 with hydrochloric acid or potassium hydroxide, and the zeta potential at each pH was measured by a zeta potential measuring apparatus of laser doppler mode (trade name: Coulter DELSA 440SX, manufactured by Coulter). Further, inorganic particle slurry and vinyl chloride latex slurry used in the following examples were dispersed in a buffer of 0.01 N potassium chloride water, and each zeta potential was measured by the same manner. The results

are shown in Table 1 and Fig. 1.

Table 1

Chelate resin		Vinyl chloride latex		Colloidal silica A		Colloidal silica B	
pH	ζ potential (mV)	pH	ζ potential (mV)	pH	ζ potential (mV)	pH	ζ potential (mV)
2.9	-44.5	2.9	10.9	3.3	-32.4	2.9	-35.9
4.3	-44.1	4.0	12.3	4.0	-35.6	3.5	-38.3
6.3	-39.3	5.2	-8.0	5.7	-40.9	6.1	-44.9
9.1	-33.0	8.5	-63.0	7.9	-42.2	8.8	-62.7
10.3	-40.2	10.0	-62.5	10.0	-48.5	10.2	-63.9

(Preparation of polish)

The resulted resin particle slurry, colloidal silica A (average particle size: 0.010 μm) as an inorganic particle, and hydrogen peroxide as an oxidizer were formulated as shown in Table 2, then, pH of the preparation was controlled to 4 using nitric acid, obtaining a polish. The polishing results are shown in Table 2.

The zeta potential of the chelate resin particle was about -44 mV and the zeta potential of the colloidal silica A was about -35.6 mV, at pH 4, read from a graph showing the correlation between pH and zeta potential in Fig. 1, namely, they were in the same sign.

Comparative Examples 1 and 2

A polish containing only the resin particles obtained in

the above-mentioned preparation of resin particle slurry was used as Comparative Example 1 and a polish containing only the above-mentioned colloidal silica A (average particle size: 0.010 μm) was used as Comparative Example 2, and formulation was effected using these polishes as shown in Table 2, then, pH was controlled to 4 using nitric acid, obtaining polishes. The polishing results are shown in Table 2.

Comparative Examples 3 and 4

Vinyl chloride latex slurry (average particle size: 0.349 μm) was used instead of the slurry of resin particles obtained by grinding the chelate resin having an iminodiacetate group as a functional group, and a polish containing only the vinyl chloride latex was used as Comparative Example 3 and a polish containing a mixed system with the above-mentioned colloidal silica A was used as Comparative Example 4, and formulation was effected using these polishes as shown in Table 2, then, pH was controlled to 4 using nitric acid, obtaining polishes. The polishing results are shown in Table 2.

The zeta potential of the vinyl chloride latex was +12.3 mV and the zeta potential of the colloidal silica A was about -35.6 mV, at pH 4, read from a graph showing the correlation between pH and zeta potential in Fig. 1, namely, they were in different signs.

Example 2

The resin particle slurry resulted in Example 1, colloidal silica B (average particle size: 0.122 μm) as an inorganic particle, and hydrogen peroxide as an oxidizer were formulated as shown in Table 2, then, pH of the preparation was controlled to 4 using nitric acid, obtaining a polish. The polishing results are shown in Table 2.

The zeta potential of the chelate resin particle was about -44 mV and the zeta potential of the colloidal silica B was about -40 mV, at pH 4, read from a graph showing the correlation between pH and zeta potential in Fig. 1, namely, they were in the same sign.

Comparative Example 5

A polish containing only the above-mentioned colloidal silica B (average particle size: 0.122 μm) was used as Comparative Example 5, and formulation was effected using the polish as shown in Table 2, then, pH was controlled to 4 using nitric acid, obtaining a polish. The polishing results are shown in Table 2.

Table 2

Slurry composition (wt%)	Ex.	Comparative Ex.					Ex.	Compara -tive Ex.
		1	1	2	3	4		
Resin particle	5.0	10.0			10.0	5.0	5.0	
Inorganic particle	5.0			10.0		5.0	5.0	10.0
Oxidizer	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Polishing speed (Å/min)	724	37	214	6	212	350	230	

As shown in Table 2, a tantalum film could be polished at high speed, by polishing using a polish containing a chelate resin particle and an inorganic particle in admixture. Scratch was not observed on the surface after polishing. On the other hand, in the cases of a polish containing only a chelate resin particle and a polish containing only an inorganic particle, the speed of polishing a tantalum film was low. Also in polishing with a polish containing the other resin than a chelate resin, and an inorganic particle in admixture, the speed of polishing a tantalum film was low.

Example 3

(Preparation of polish)

The resin particle slurry obtained in Example 1, colloidal silica A (average particle size: 0.010 μm) as an inorganic particle, nitric acid as a polish accelerator and hydrogen peroxide as an oxidizer were formulated as shown in Table 3,

obtaining a polish composition. The results are shown in Table 3.

Example 4

A polish composition was obtained in the same manner as in Example 3 except that nitric acid was replaced by ammonium nitrate. The results are shown in Table 3.

Comparative Example 6

The resin particle obtained in the above-mentioned preparation of resin particle slurry, ammonium nitrate as a polish accelerator, and hydrogen peroxide as an oxidizer were formulated as shown in Table 3, obtaining a polish composition. The results are shown in Table 3.

Comparative Example 7

The above-mentioned colloidal silica A (average particle size: $0.010 \mu\text{m}$), ammonium nitrate as a polish accelerator, and hydrogen peroxide as an oxidizer were formulated as shown in Table 3, obtaining a polish composition. The results are shown in Table 3.

Comparative Example 8

Glycine as a chelate compound instead of the slurry of resin particles obtained by grinding a chelate resin, and ammonium

nitrate as a polish accelerator, and hydrogen peroxide as an oxidizer were formulated as shown in Table 3, obtaining a polish composition. The results are shown in Table 3.

Example 5

The resin particle slurry obtained in Example 1, the colloidal silica B (average particle size: 0.122 μm) as an inorganic particle, ammonium nitrate as a polish accelerator, and hydrogen peroxide as an oxidizer were formulated as shown in Table 3, obtaining a polish composition. The results are shown in Table 3.

Comparative Example 9

The above-mentioned colloidal silica B (average particle size: 0.122 μm), ammonium nitrate as a polish accelerator, and hydrogen peroxide as an oxidizer were formulated as shown in Table 3, obtaining a polish composition. The results are shown in Table 3.

Table 3

Slurry composition (wt%)	Ex.		Comparative Ex.			Ex.	Compar- ative Ex.
	3	4	6	7	8		
Chelate resin particle	10	10	10			10	
Chelate compound					10		
Inorganic particle	8.3	8.3		8.3	8.3	8.3	8.3
Polishing accelerator	2.0	2.6	2.6	2.6	2.6	2.6	2.6
Oxidizer	2.5	2.5	2.5	2.5	2.5	2.5	2.5
pH	4.0	8.6	8.7	4.0	5.0	8.9	7.1
Polishing speed (Å/min)	922	632	40	355	277	480	369

As shown in Table 3, a tantalum film could be polished at high speed, by polishing using a polish containing a chelate resin particle, inorganic particle and nitric acid or nitrate. Scratch was not observed on the surface after polishing. On the other hand, in the case of a polish containing a chelating agent instead of the chelate resin, the speed of polishing a tantalum film was low.

Example 6

(Preparation of polish)

The resin particle slurry obtained in Example 1, colloidal silica A (average particle size: 0.010 μm) as an inorganic particle, ammonium nitrate as a polish accelerator and hydrogen peroxide as an oxidizer were formulated as shown in Table 4,

obtaining a polish composition. The results are shown in Table 4.

Comparative Example 10

The resin particle obtained in the above-mentioned preparation of resin particle slurry of Example 1, ammonium nitrate as a polish accelerator, and hydrogen peroxide as an oxidizer were formulated as shown in Table 4, obtaining a polish composition. The results are shown in Table 4.

Comparative Example 11

Glycine as a chelate compound instead of the resin particle slurry in Example 1, and ammonium nitrate as a polish accelerator, and hydrogen peroxide as an oxidizer were formulated as shown in Table 4, obtaining a polish composition. The results are shown in Table 4.

Example 7

(Preparation of chelate resin slurry)

1 L of a chelate resin having an iminodiacetate group as a functional group (trade name: Sumichelate MC-700, manufactured by Sumitomo Chemical Co., Ltd., counter ion : Na type) was filled in a column and washed with ultrapure water, then, 10 L of a 2 N hydrochloric acid aqueous solution was passed through this, and washed again with ultrapure water, to give

a chelate resin of H type. Further, 2 N ammonia water was passed through this, and washed again with ultrapure water and dehydrated, to obtain a chelate resin of ammonium type. 27.5 kg of a chelate resin of ammonium type obtained by the same treatment was dry-ground by Impeller mill (trade name: manufactured by Seishin Kogyosha K.K.). This was conducted under grinding conditions of a rotor revolution of 6000 rpm and a feeding rate of 15 kg/hr, to obtain 23.3 kg of a ground product. The average particle size of the ground product was 43 μm .

6.9 kg of ultrapure water was added to 2.6 kg of the resulted ground product and the mixture was stirred to obtain a dispersion, and this was wet-ground by Dinosaur mill (trade name: manufactured by Shinmal Enterprise K.K.). This was conducted under grinding conditions of a peripheral speed of 14 m/sec. and a feeding rate of 0.5 L/min, with 10 passes. The average particle size of the resulted chelate resin particles was 0.32 μm .

In the resulted slurry, the colloidal silica A (average particle size: 0.010 μm) as an inorganic particle, ammonium nitrate as a polish accelerator and hydrogen peroxide as an oxidizer were formulated as shown in Table 4, obtaining a polish composition. The results are shown in Table 4.

Table 4

Slurry composition (wt%)	Ex.	Comparative Ex.		Ex.
	6	10	11	7
Chelate resin particle	1.0	1.0		1.0
Chelate compound			1.0	
Inorganic particle	1.0		1.0	1.0
Polishing accelerator	2.6	2.6	2.6	2.6
Oxidizer	6.0	6.0	6.0	6.0
pH	7.6	7.8	4.7	6.1
Ta Polishing speed (Å/min)	453	2	270	495
SiO ₂ Polishing speed (Å/min)	11	3	10	7
Ta/SiO ₂ selection ratio	41	0.7	27	71

As shown in Table 4, by polishing using a polish containing a chelate resin particle, inorganic particle and polishing accelerator in admixture, the ratio of the polishing speed of a metal film to the polishing speed of an insulation film was high, and a metal film could be polished selectively. Scratch was not observed on the surface after polishing. On the other hand, in the case of a polish containing a chelating agent instead of the chelate resin, the ratio of the polishing speed of a metal film to the polishing speed of an insulation film was low, and a metal film could not be polished selectively.

According to the present invention, a metal film can be polished at high speed in producing a semiconductor device.

BRIEF DESCRIPTION OF A DRAWING

Fig. 1

Fig. 1 illustrates a relationship between pH and zeta potential.